EAGE and Ground Software

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Requirements From MRD-GSW

- Shall Provide Command and Telemetry System for All Phases of FAME
- Shall Provide Command, Control, and Telemetry System for MOC and SOC
- Shall Be Compatible With BP Ground System Architecture
- Shall Control the FAME Hardware Paths (Ex. Antenna(s)) at BP
- Shall Provide Control of the Ground System Configurations Via an Extendible Script Language
- Shall Support Telemetry Acquisition and Processing of the FAME CCSDS Data Stream at the FAME Data Rates
- Shall Forward Science Data Packets and Instrument SOH Packets to the SOC in Real-Time - TBR
- Shall Support Monitoring of FAME Including System Status Analysis, Limit Checking, Out of Limits Reporting and Trending Analysis
- Shall Support Telemetry Archive and Playback for Both Science Data and SOH Data
- Shall Support Command Uplink and Verification
- Shall Support Three Command Modes: Real-Time, Ground Preplanned and Onboard Scheduling Based on Uplinked Command Loads
- Shall Support Verification of Command Execution, Analysis of Results, Investigation of Anomalies, and Response to Off-Nominal Situations
- Shall Support Initiation of Safing Measures Whenever It Is Determined That a Critical Event Jeopardizes the Mission
- Shall Support Calculation of S/C Velocity, Range and Range Rate to 1cm/sec

Requirements From MRD-EAGE

- **Protect Flight Hardware During Test**
- **Provide CCSDS Uplink to Spacecraft**
- **Accept Downlink to Spacecraft**
- **Provide 30+/ -6 VDC Power to Spacecraft for System Level Testing and Pre-Launch Activities**
- **Simulate/Provide 600W at 28 VDC Solar Array/Battery Power**
- **Provide Spacecraft Critical Bus/Component Protection From EAGE Overvoltage and/or Overcurrent Anomalies**

EAGE/GSW Requirements Testing

- **All MRD Level Requirements Will Be Validated Using “TEST” Method**
- **Derived Requirements for GSW Are in the Software Requirement Spec (NCST-SRS-FM002)**

EAGE Systems

- FSC Test Bed (FTB) in A59
- Software Only Test Bed (SOTB) in T970 (No FEP)
- Software Only Test Bed (SOTB) in Melbourne Fl. (No FEP)
- Software Test Bed (STB) in T970
- EAGE in A59
- ELSE

FSC Box-Level Testing/Interfaces

C&T Workstation Running Solaris & OSComet

Ethernet

Ethernet/GPIB converter

GPIB

HP 6032A Power Supply

Bus Protection Unit

30VDC

FIT VME Chassis running VxWorks

- SEI CMD encoder
- Avtec RSDEC
- SBS Power 7E
- SBS 1553 (rt)
- SEI Msn I/F
- Datum bc366 timer
- SEI ARC Sim. etc.

2 kb/s

1, 2, 8,16, 250, 500Kb/s

Startracker, RIU

Cmds/Mission Data/Sync Clk

- Paraffin Actuators
- IMUs, Magnetometer
- Latch & Thruster Valve Drivers
- Sun Sensors
- Torque Rods

FSC

- Power Converter
- Uplink/Downlink (UDM)
- RHC 3001 CPU
- 1553 (bc)
- Digital Data Rcdr (DDR)
- Star Catalog (StCat)
- Attitude/Reaction (ARC)
- Inst. Control I/F (ICI)
- Enet for SW Development

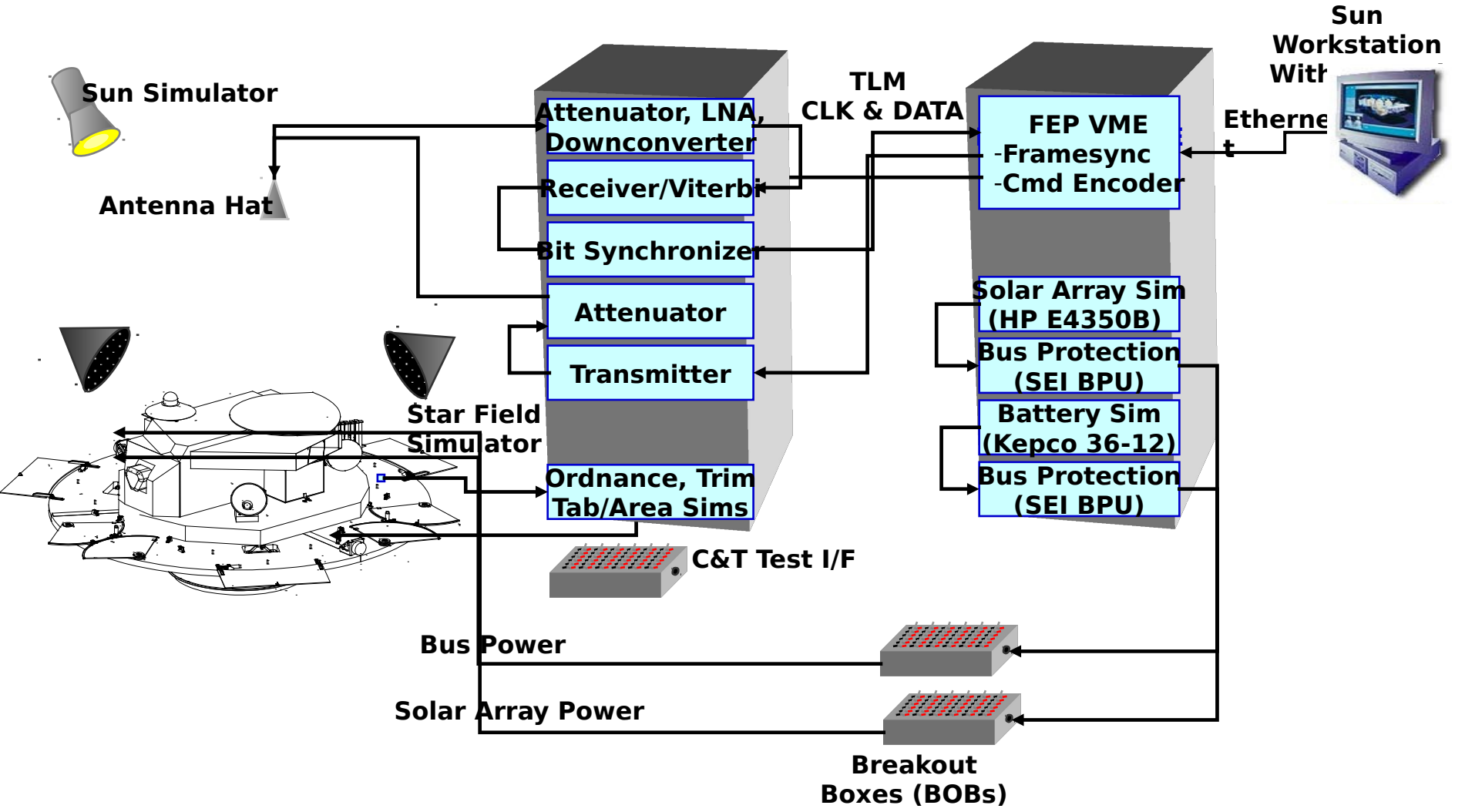
VME Bus

FSW Workstation (for Debug)

RIU / RIUsim Via 1553

- High Level (28V Pulse) Commands
- Low Level (5V) Commands
- Serial Commands
- Active & Passive Tlm (Temps & Volts)
- Bi-level Tlm

FAME EAGE Interfaces

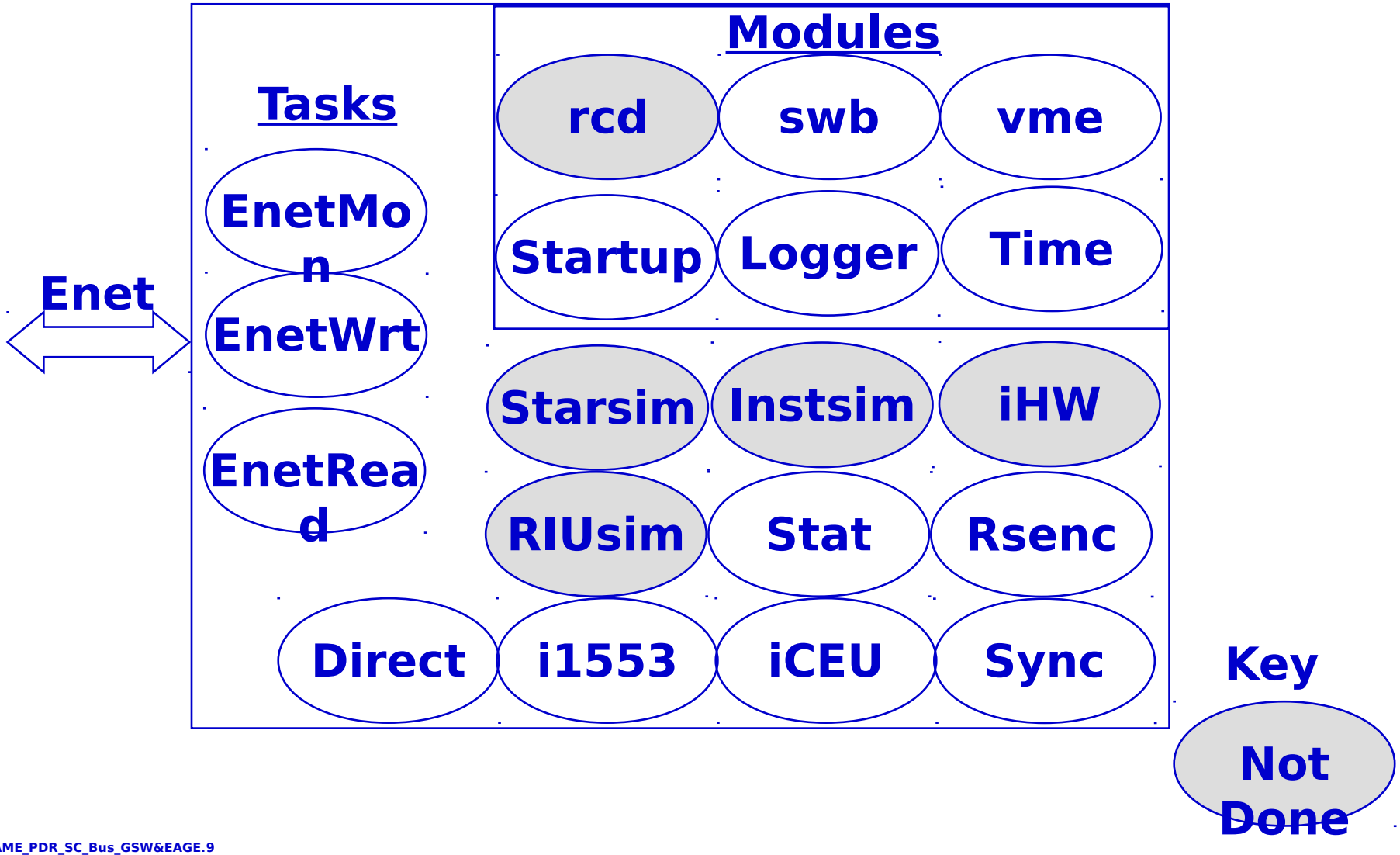


* Most Testing Scenarios Do Not Use Antennas

GSW Status

- **Command and Telemetry Works With Flight Code via Enet Interface**
- **Oracle Flight SW Database (From ICM) Converted to OSComet C&T Databases**
- **Using Latest NRL's OSComet From BP, Working Well**
- **FEP Software/Hardware Is Working (See the Next Slide):**
  - **CEU Card Validated**
  - **Frame Sync Card and Time Assignment Tested**
  - **SBS1553 Card Working**
  - **Enet Interface and Most Utility Code Working**
- **FEP Testing With FSC 1553 Bread Board Is Working With a Simple Schedule**

FEP Design/Status



FEP LOC

Task/Module	Description	Status	LOC (20011018)
Includes	FEP Shared Include Files	90% Complete	1237
ceu	Cmd Encoder Task	Complete	574
server	Ethernet Tasks	Complete	345
VME Direct	VME Direct Access Task	Complete	205
1553	1553 Interface	95% Complete	4951
Logging	Logging Module	Complete	365
RSENC	RS Encoder Task	Complete	829
Startup	Startup Routine	Complete	133
Status	Status Task	Complete	370
Sync	RS Decoder (Frame Sync)	Complete	3280
TimeCode	Time Card Module	Complete	572
Util	Util, Enet, VME, SWB Code	Complete	2936
Total			15797

C&T LOC

Task/Module	Description	Status	LOC (20011026)
Includes	Inluce files	80% complete	3565
tlmasi	Application Specific Input	70% complete	5849
tlmprc	TLM procesing of frames	70% complete	4320
cmdcse	Formatting Commands	80% complete	8948
cmdaso	Output of Commands	80% complete	1522
db	Database	40% complete	9243
gmd_utils	Ground Utilites	60% complete	7032
gsec	Ground Station Control	100% complete	5952
dbgen	Database Tools	90% complete	7576
libcomm	BP Common library	100% complete	5045
lpc_user	LPC User Functions	80% complete	2489
memxltr	Memory Translator	100% complete	965
objxltr	Object translator	100% complete	37969
rptgen	Report Generator	100% complete	3144
pktgen	Creates Displays	100% complete	3173
scl	SCL code	95% complete	1974
toolbox	Test menu environment	100% complete	3501
utils	Utility Library	50% complete	297
TOTAL			112564

Issues

- **Simulation fidelity - ex. Attitude Simulations and Mission Data**
  - **Attitude Simulation Will Run on the FEP - Design Issues**
- **Data Processing of Instrument Data for SOC at USNO Is TBD**
- **Avtec Frame Sync Card Up to a 31us Time Assignment Error**
- **Time Assignment Error Budget - How Much of the 1 ms Do We Get?**
- **Design Issues of Using BP FEP vs. EAGE FEP for Operation**

Procurement Status

- **All Items (Except for Two VME Cards) Needed for FSC Box-Level Testing Are Available**
  - **These Two Cards Will Be Available After PDR - No Schedule Issue**
- **There Are No Long Lead Items for the EAGE**
- **Spread Sheet of the EAGE Items Are in the Backup Slides**

Top Level Schedule

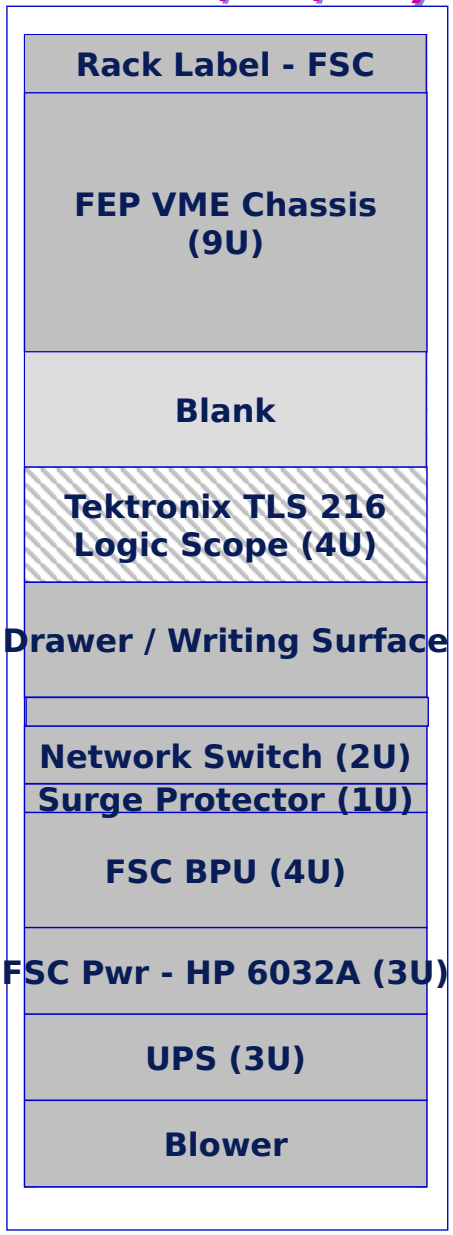
- **FAME PDR** **Oct 2001**
- **EAGE Peer Review** **Sep 2001 Complete**
- **Initial FEP Complete** **Oct 2001**
- **FEP Supports FSC Board Level Testing** **Oct 2001 Started**
- **FEP Supports FSC Box Level Testing** **Nov 2001**
- **Space/Ground ICD Available** **Oct 2001 On Web Site**
- **EAGE System Demonstration (ATP)** **Dec 2001**
- **FAME CDR** **Aug 2002**
- **EAGE System Available for Test** **Jun 2002**

Backup

Staffing

- **Eric Karlin - Full Time**
  - **GSW Development Environment, Requirements, Space/Ground ICD, CM Plan, C&T Design/Develop, C&T Databases, etc.**
- **Jeff Johnson - Full Time**
  - **Requirements, FEP Design/Development, IV&V Contact,System Administration**
- **Jeff Cleveland - When Available**
  - **Lead I&T Starting in 2002 - After WindSat**
- **Paul Jaffe**
  - **Lead Hardware**
- **TBD - Apr. 2002 thru Oct. 2003**
  - **Software and Testing**

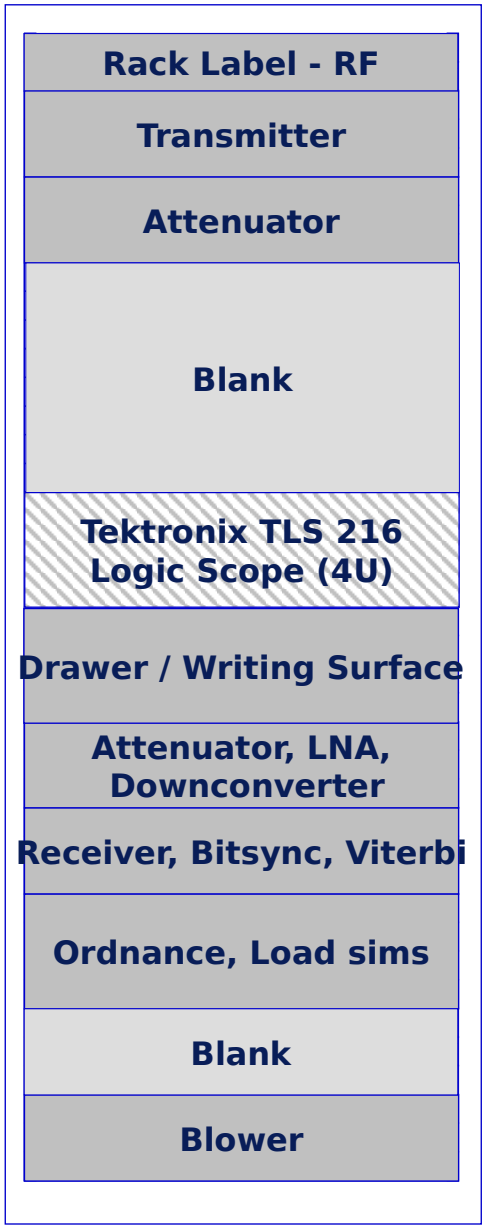
FAME FTB Rack
(Rev A 2001/08/13)

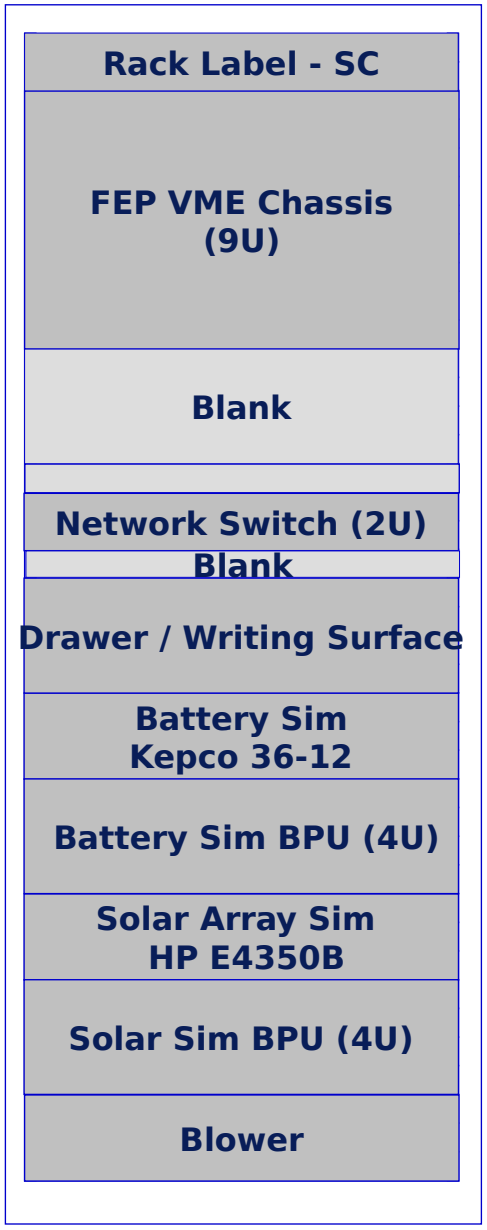


Note:1U=1.75“=44.45mm

Additional Equipment: Sun Workstation, Monitor,GPIB/Enet Converter

FAME EAGE Racks
(Rev B 2001/08/13)



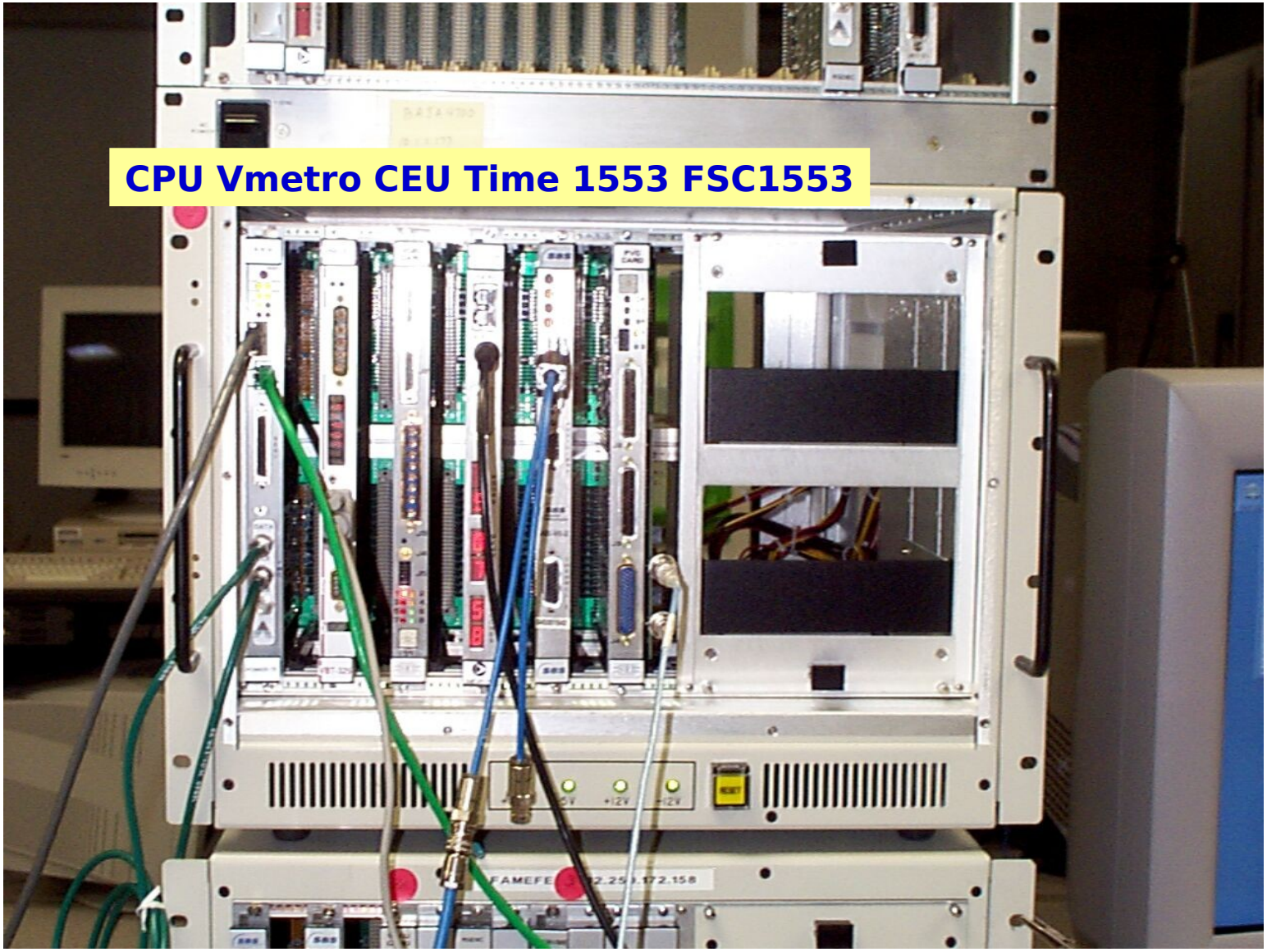


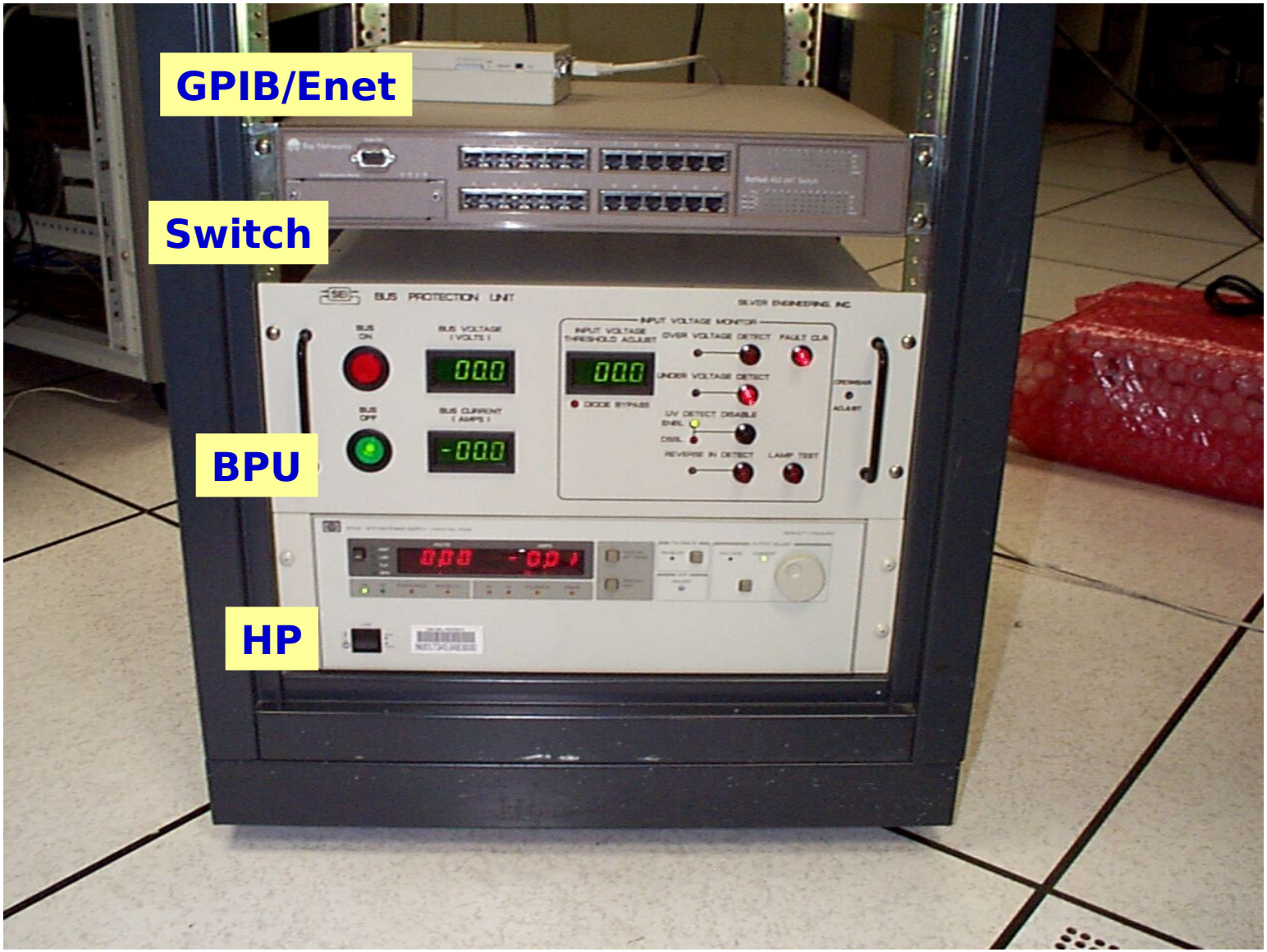
Note:1U=1.75“=44.45 mm

Additional equipment:

Sun Workstation, monitor, GPIB/Enet

FEP
(With FSC 1553 Bread Board)



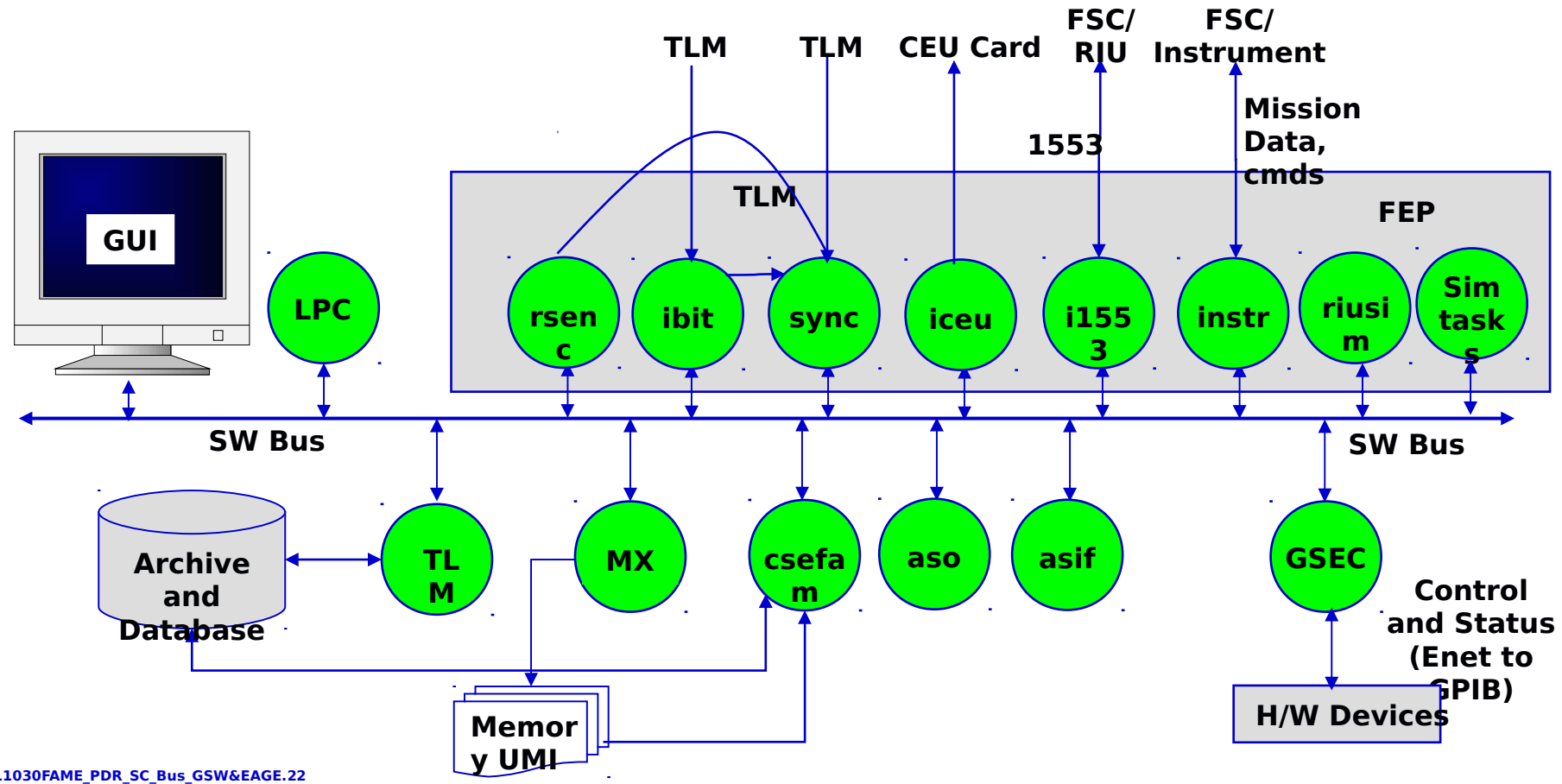

GPIB/Enet
Switch
BPU
HP
BUS PROTECTION UNIT

Design Requirements/Approach

- Complete Automation - Complete Control/Insight
- System Shall Use a Sun Solaris Platform for C&T Using NRL's OSComet
- Front-End Processor (FEP) Shall Be a VME Chassis Running the VxWorks OS
- Housekeeping Telemetry and Commands Are Passed Via 100 Mb Ethernet Between the FEP and the C&T Nodes
- SW Interfaces Use CCSDS Application Packet Format
- All C&T Data Is Archived on the FEP As Well As the Sun
- Software Shall Be Written in "C"
- Scripts Shall Be Written in csh, sh, tcl, or perl
- Code Re-Use Is the Key to Productivity (ICM, WINDSAT, NEMO, BP)
- The LAN for Formal Testing Shall Be Isolated From the NRLnet
- Shall Support a Heterogeneous Network of Nodes for Off-Line Analysis (PCs and MACs Will Be Able to Mount Our File System to Analyze Data Offline)
- Physical Interfaces Shall Be Isolated From the Application Software via a Separate Executable or Threads (Ex. Commanding System and the CEU Handler, Payloadsim and the I1553 Task)
- System Shall Provide APIs to Isolate and Control
- WEB Browser Shall Be Supported Using ITOS

EAGE Ground SW Design

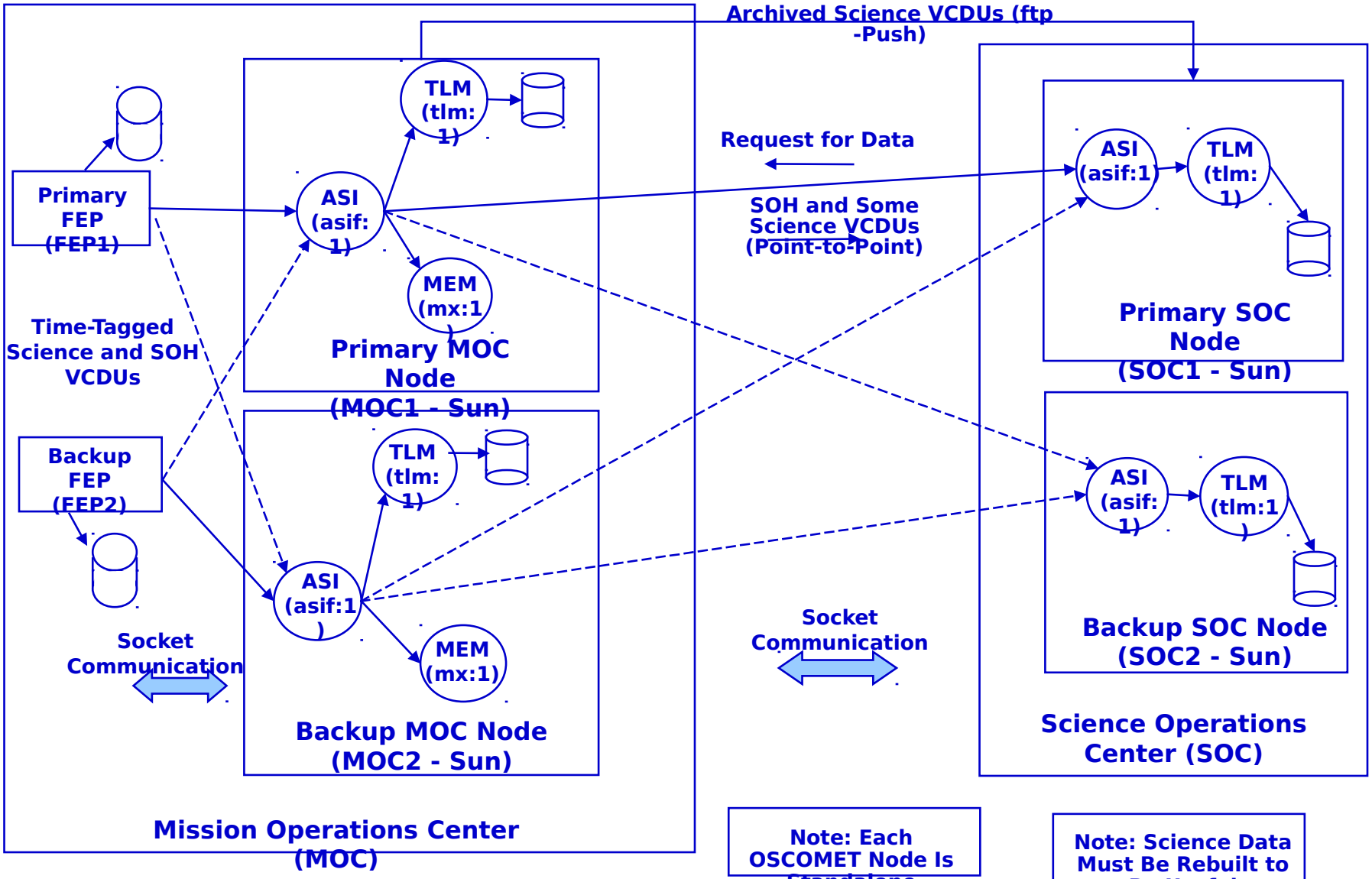
1. The Software Bus Allows Us to Configure Processing Components on Any Node in the LAN
   - The Telemetry and Commands May Come From/Go to Any Interface (1553, CEU, Frame Sync, Instrument Data)
2. Interface Tasks (Ex. I1553) Handle All Hardware Specifics
   - Simulation Tasks Control the Interface Tasks Via the Software Bus
   - Simulations Are Independent From the Physical Interfaces



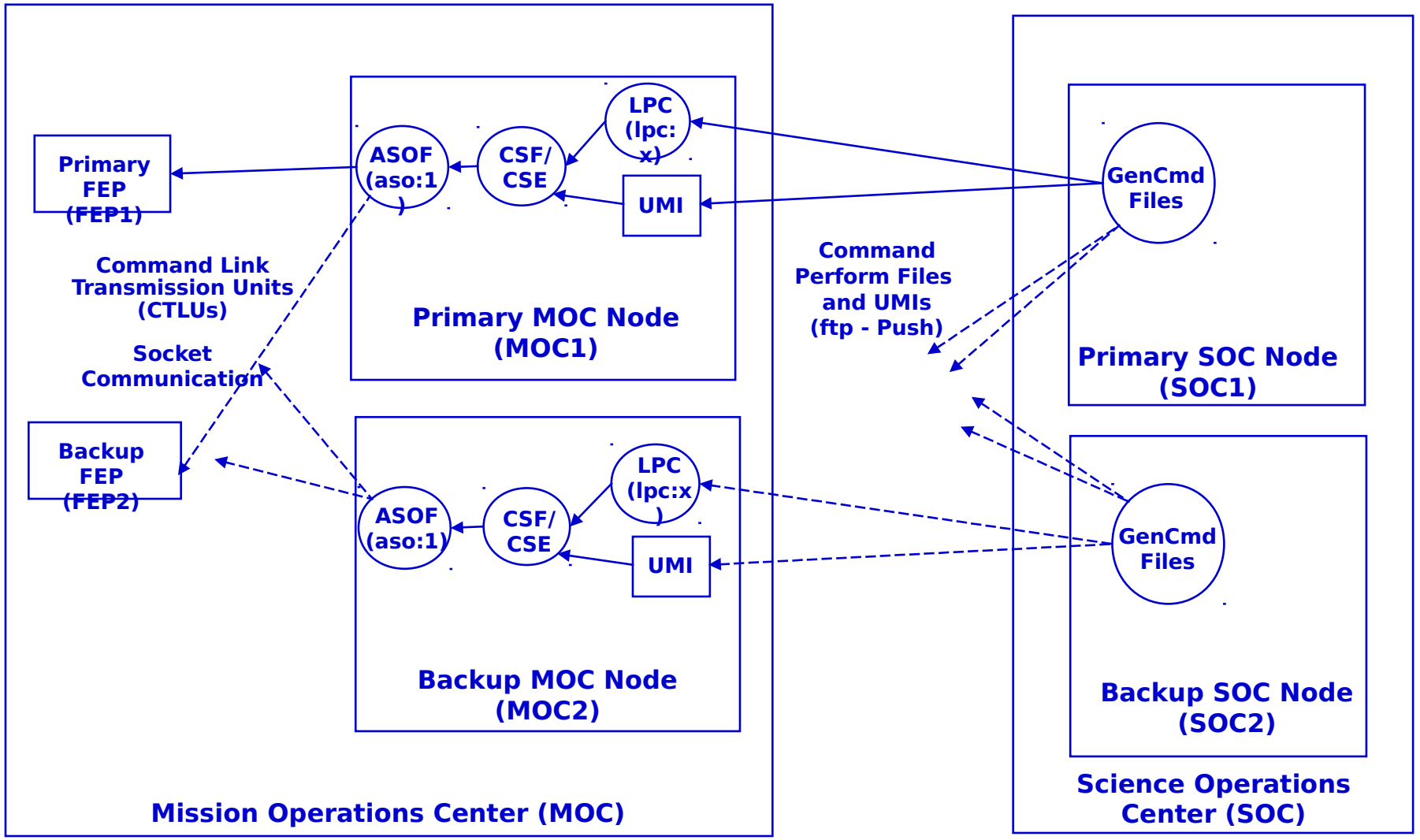
C&T Design Approach

- **Provide a MOC/SOC Distributed Data System But Not a WAN Distributed OS/COMET Application**
- **Provide Redundancy Using a Simple Primary/Backup Approach**
- **Work With BP to Define Control Requests and Status Responses for Shared Ground Station Equipment (E.G. Antenna, Transmitter)**
- **Reuse Design and Code Fragments From ICM (E.G. TLMASI, TLMPRC) and WINDSAT/NEMO (e.g. asiw, cmd, ccsds) As Much As Possible**
- **Use Oracle DB to Store Command and Telemetry (CAT) Information**
  - **Data Items (Symbols), Packet Formats (Decom), Commands**
  - **Single Point Definition With Generation of Documentation, OS/COMET Databases, and C Code**
- **Provide Web-Based Near-Real Time Telemetry Display of High Level Status Using ITOS**
- **Provide Web-Based Historical Display of High Level Status Using Oracle DB and Oracle Portal**

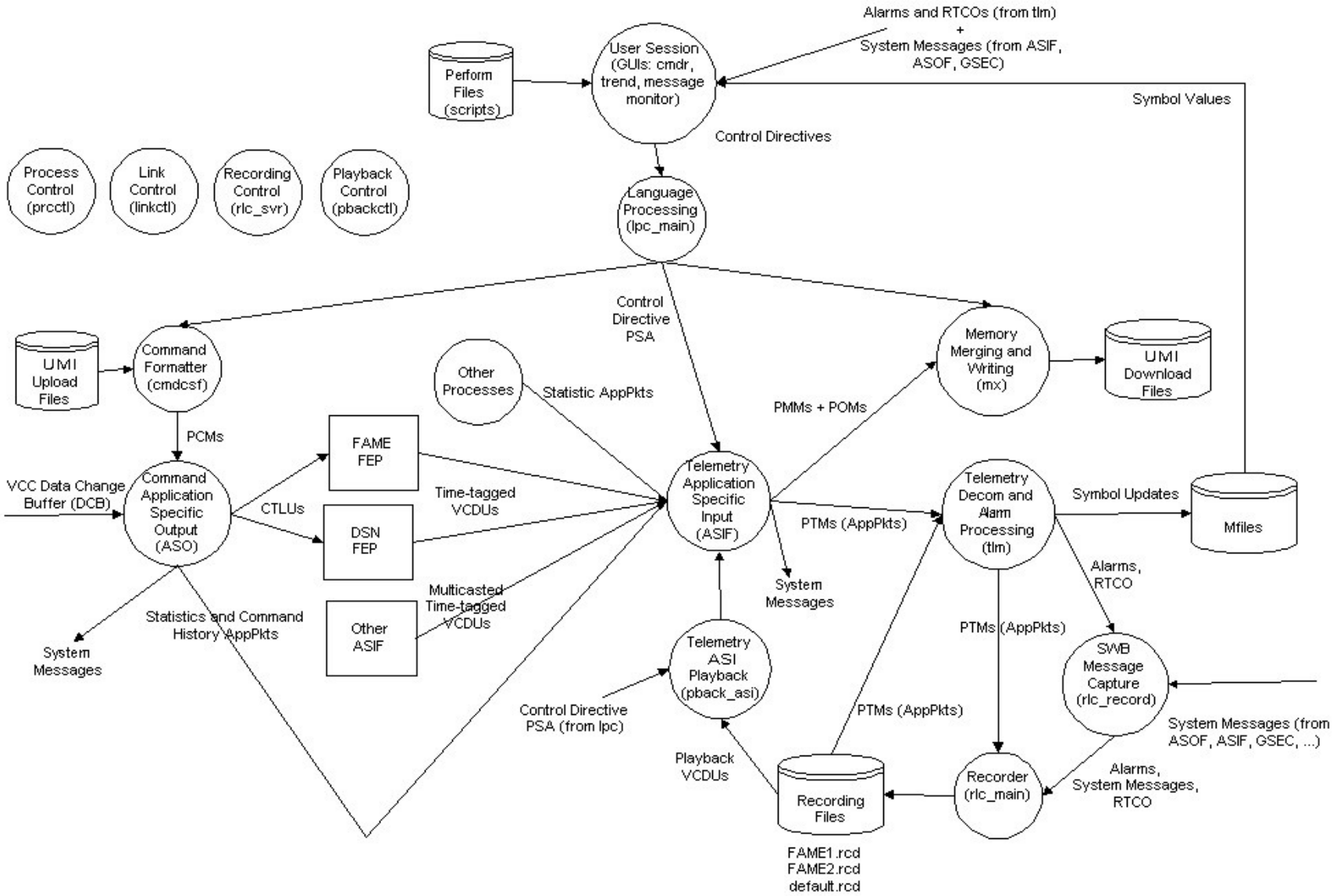
Telemetry Distribution Design-TBR



Commanding Design



C&T Design
Detailed Tasks and Data Interfaces

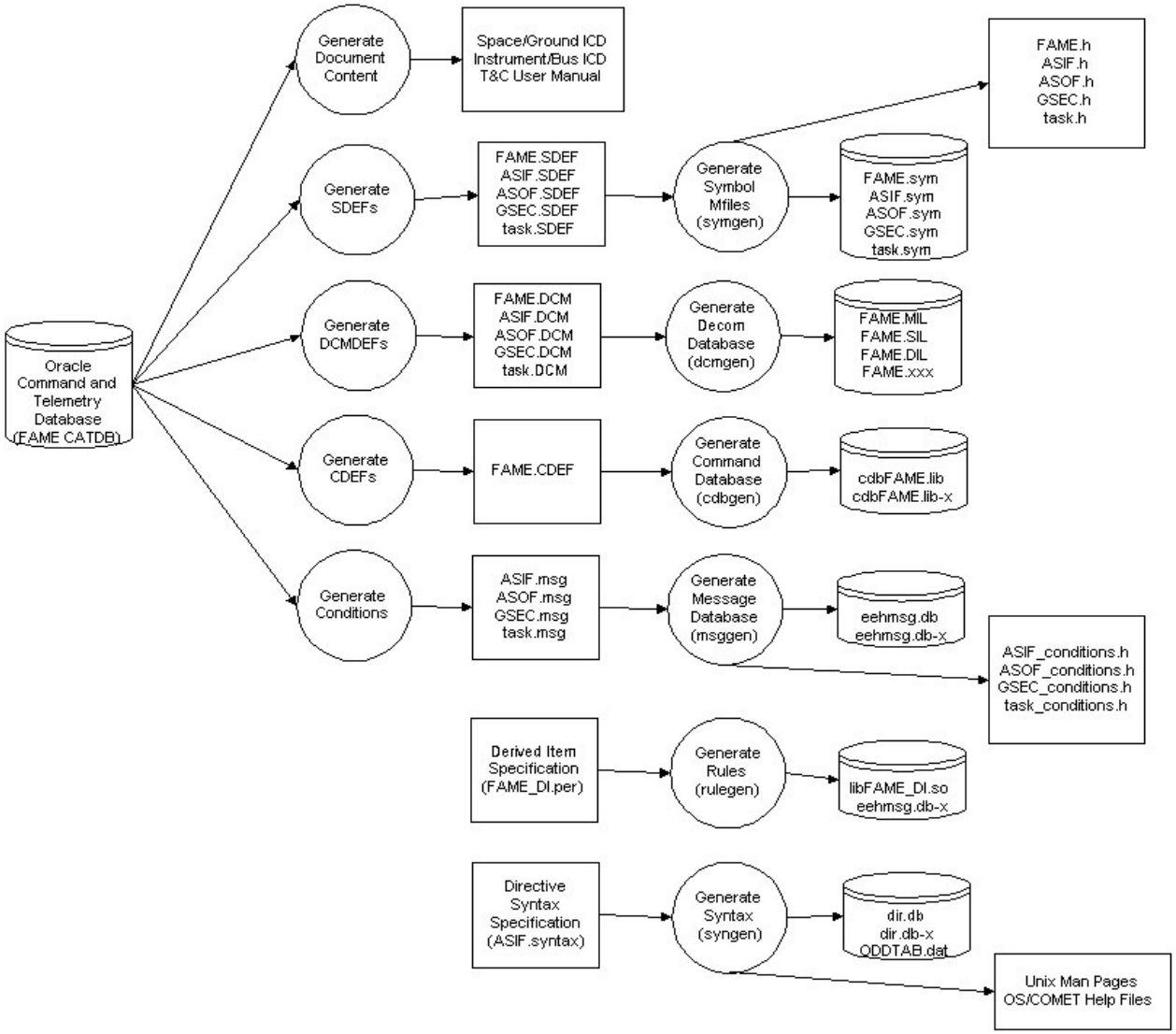


C&T Design
Data Interfaces

- Between DSN and MOC - TBD
- Between MOC (i.e. BP) and SOC
  - SOC to MOC – Science Tasking /Commanding in OSCOMET Perform Files
  - SOC to MOC – Request for Telemetry/Science VCDUs
  - MOC to SOC – Science VCDUs in OS/COMET Recording Files - FTP Push
  - MOC ASIF to SOC ASIF – Multicast Time-Tagged VCDUs Packaged in AppPkts
- Between FAME FEP and NRL C&T/Control Node at MOC (TBR)
  - Operations and Control (OAC) Node to FAME C&T Node
    - Control Perform File Execution (Setup, Shutdown, Ranging etc.)
  - FAME C&T Node to BP Control Nodes
    - Request to Use Hardware - (ex. Antenna Controller, Uplink Matrix)
- Between FAME FEP and FAME C&T Nodes at MOC
  - FEP to ASIF – Time-Tagged VCDUs Packaged in Application Packets (AppPkt)
  - ASOF to FEP – Command Link Transmission Units (CLTU)
- Between FAME C&T Processes
  - ASIF to TLM – Packaged Telemetry Messages (PTMs)
  - ASIF to MEM – Packaged Memory/Object Messages (PMMs, POMs)
  - CSF to ASOF – Packaged Command Messages (PCMs)
  - Misc Processes to ASIF – Statistics in AppPkts to Be Decommed

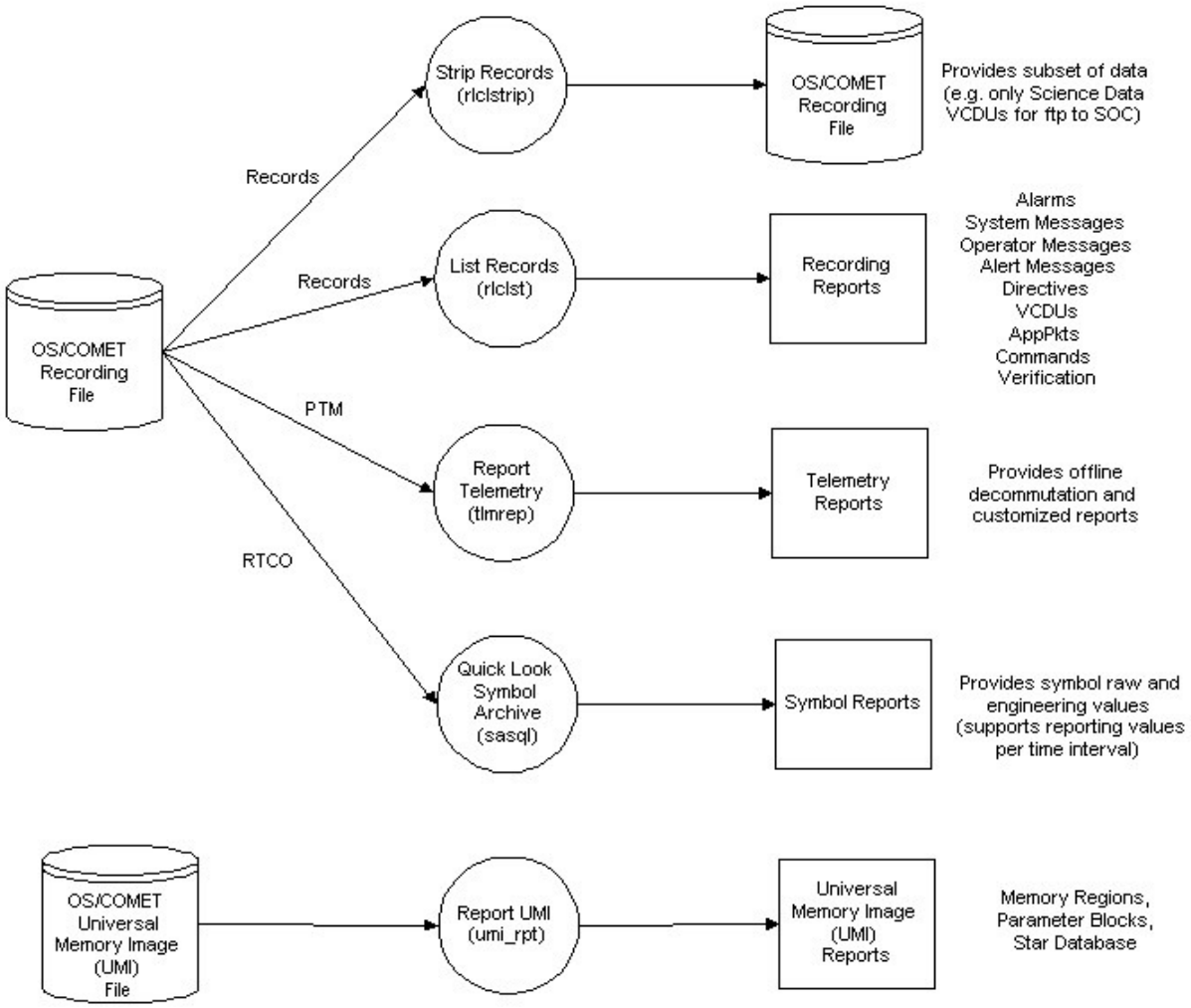
C&T Design
Processing Specification Tools

FAME CAT Offline Specification



C&T Design
OS/COMET Offline Tools

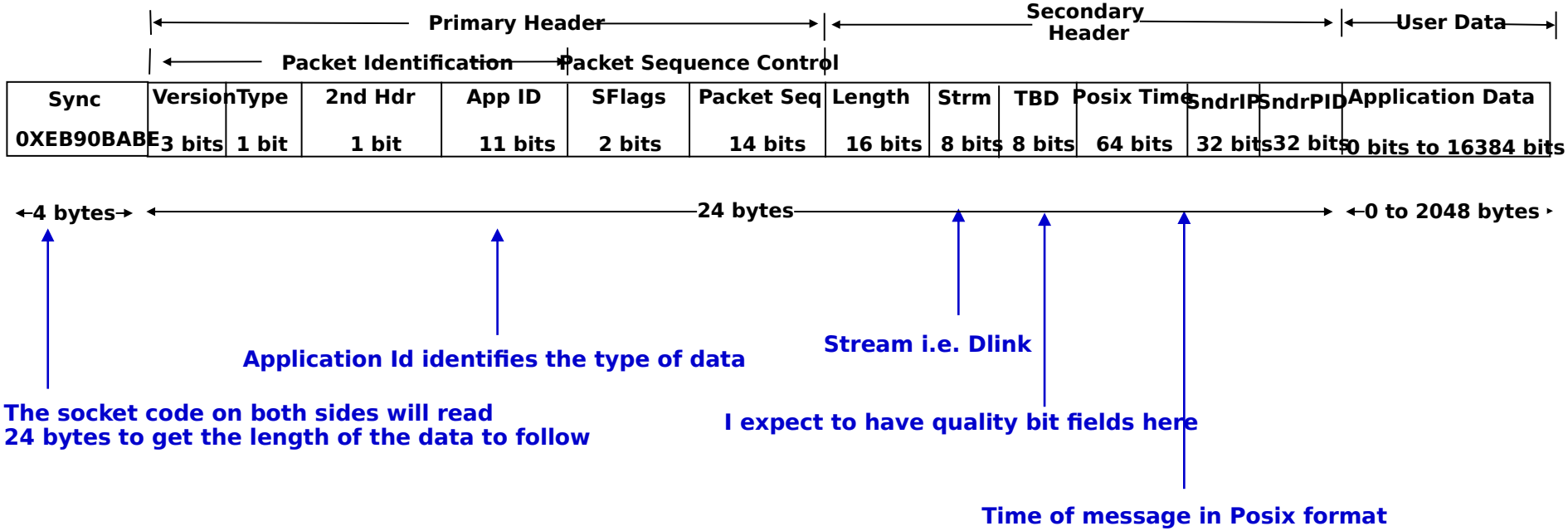
FAME CAT Offline Processing and Analysis



FEP Design

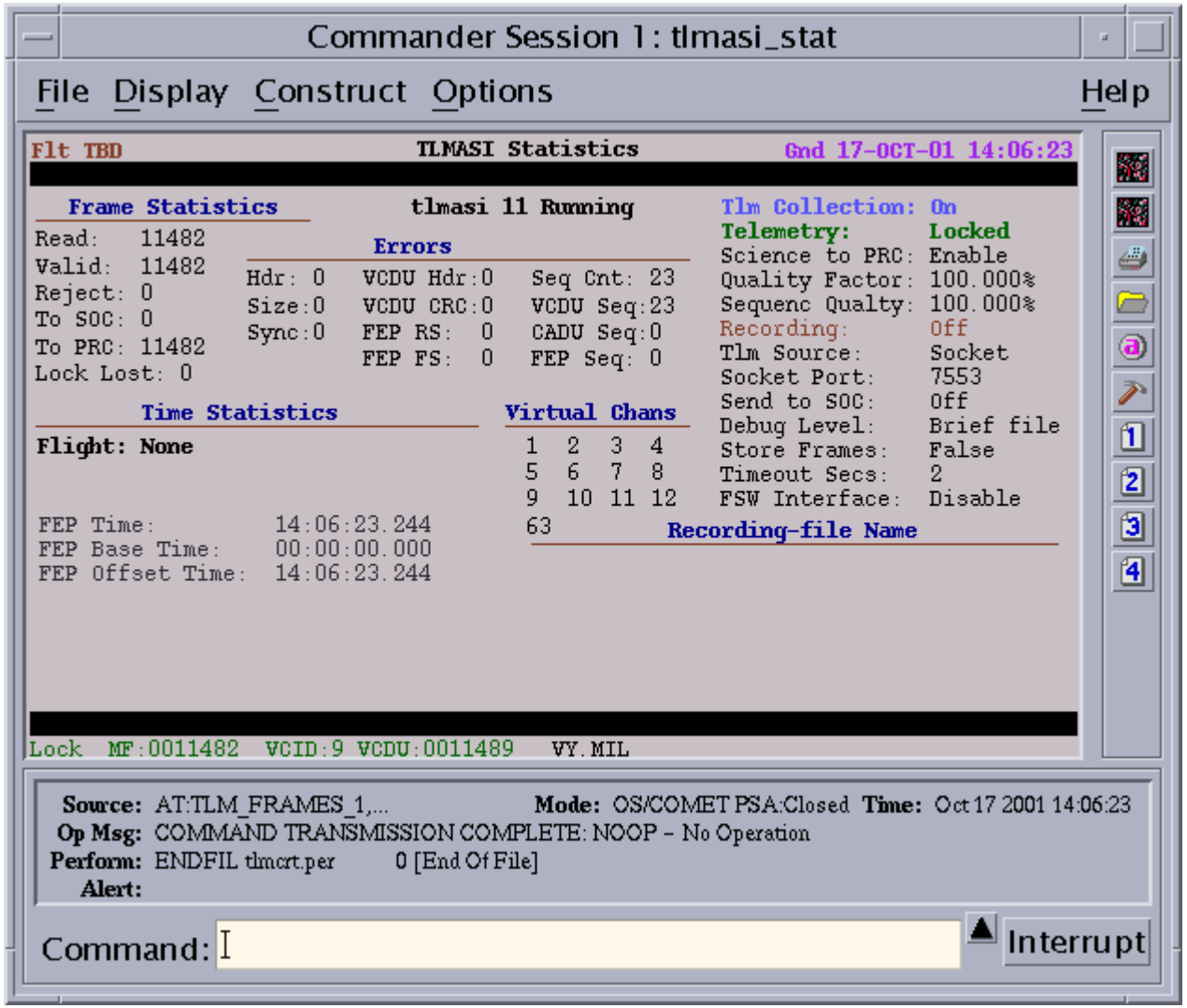
- All Control From OSComet Syntax With Defaults for FAME C&T
- FEP Will Boot From the Sun Host
- FEP Will Log Using Files on the Sun Host (i.e. NFS to Sun Disk)
- FEP Will Provide Browser Viewable Status Via the C&T System - Not From the FEP
- FEP Will Support Archive Within 18 Months - Format Will Be OSComet RCD Files
- Using CCSDS Application Packets As Method of Inter-Process Communication
- All FEP Tasks Will Probe the VME to See If Their Card Is in the Chassis
- The FEP Will Not Process the Packets Inside the VCDUs
  - This Will Be Done by the ASI on the Sun Nodes
  - The FEP Will Frame Sync, Derandomize, RS Check and Time Assign
- Time Assignment to Be Done As Follows:
  - Gather “Base Time” in Us From GPS Time Card Before You Start Collecting Frames
  - Init the Frame Sync Card Which Uses the 33.333MHz PCI Clock to Count Ticks (Set Count to Zero)
  - The Card Also Supports an External Clock - We Will Use This During Operations
  - Sync Card Reports It’s Clock (i.e. Counter) With Each Frame - Last Bit of Frame

FEP Socket/Message Interface

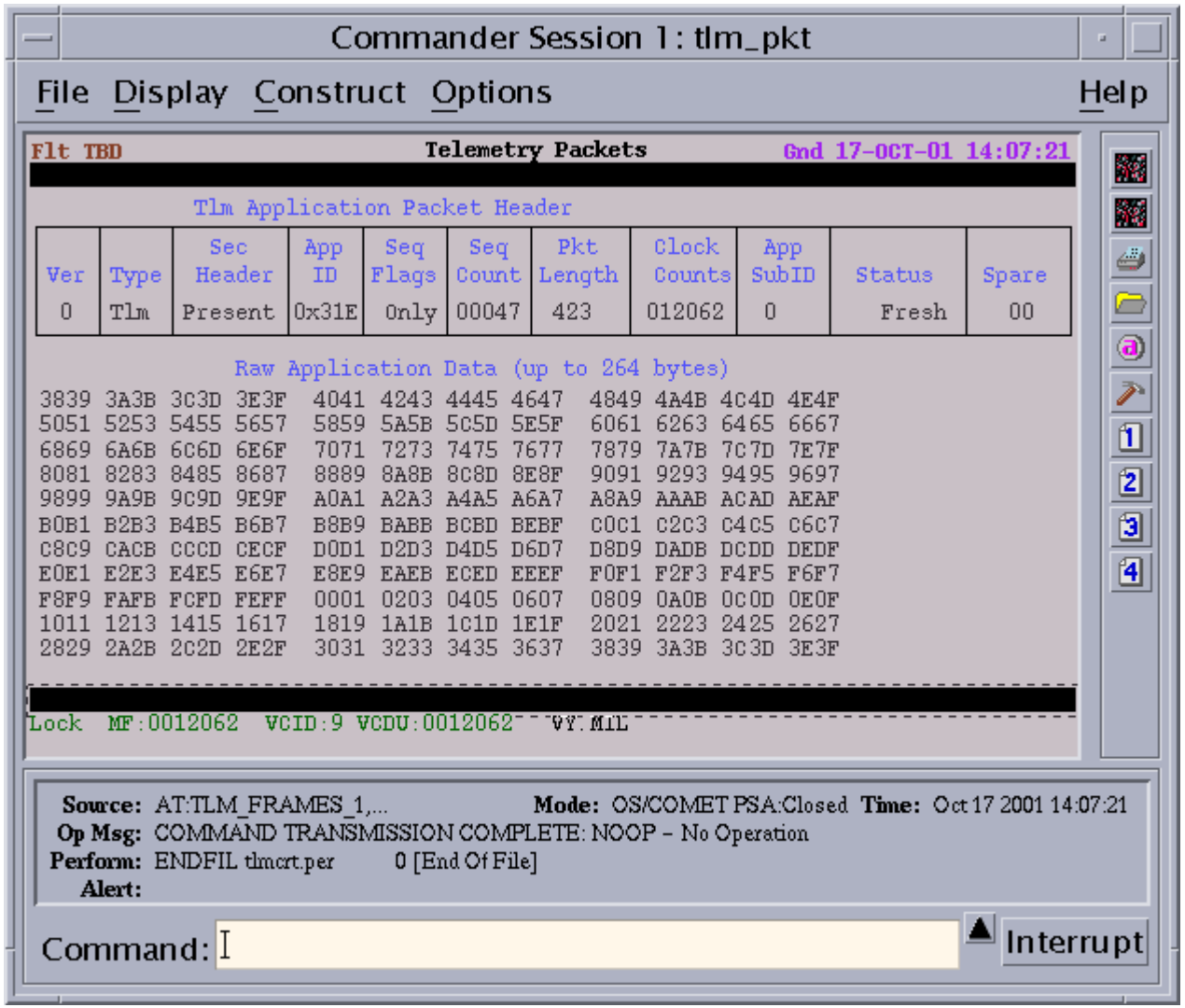


All inter-task messages on the FEP will use this format (minus the sync pattern)

Telemetry Stats



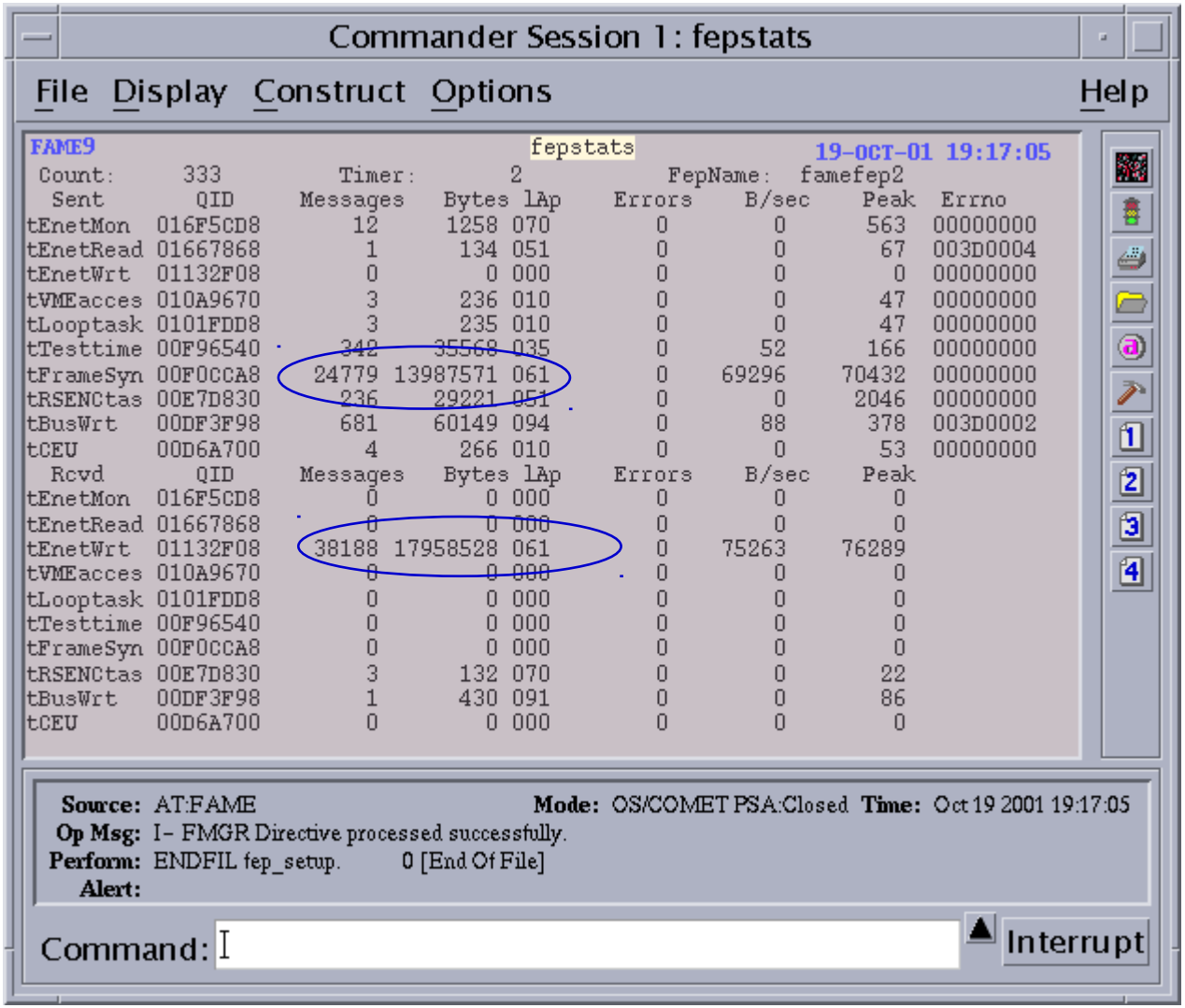
Raw Telemetry Frame



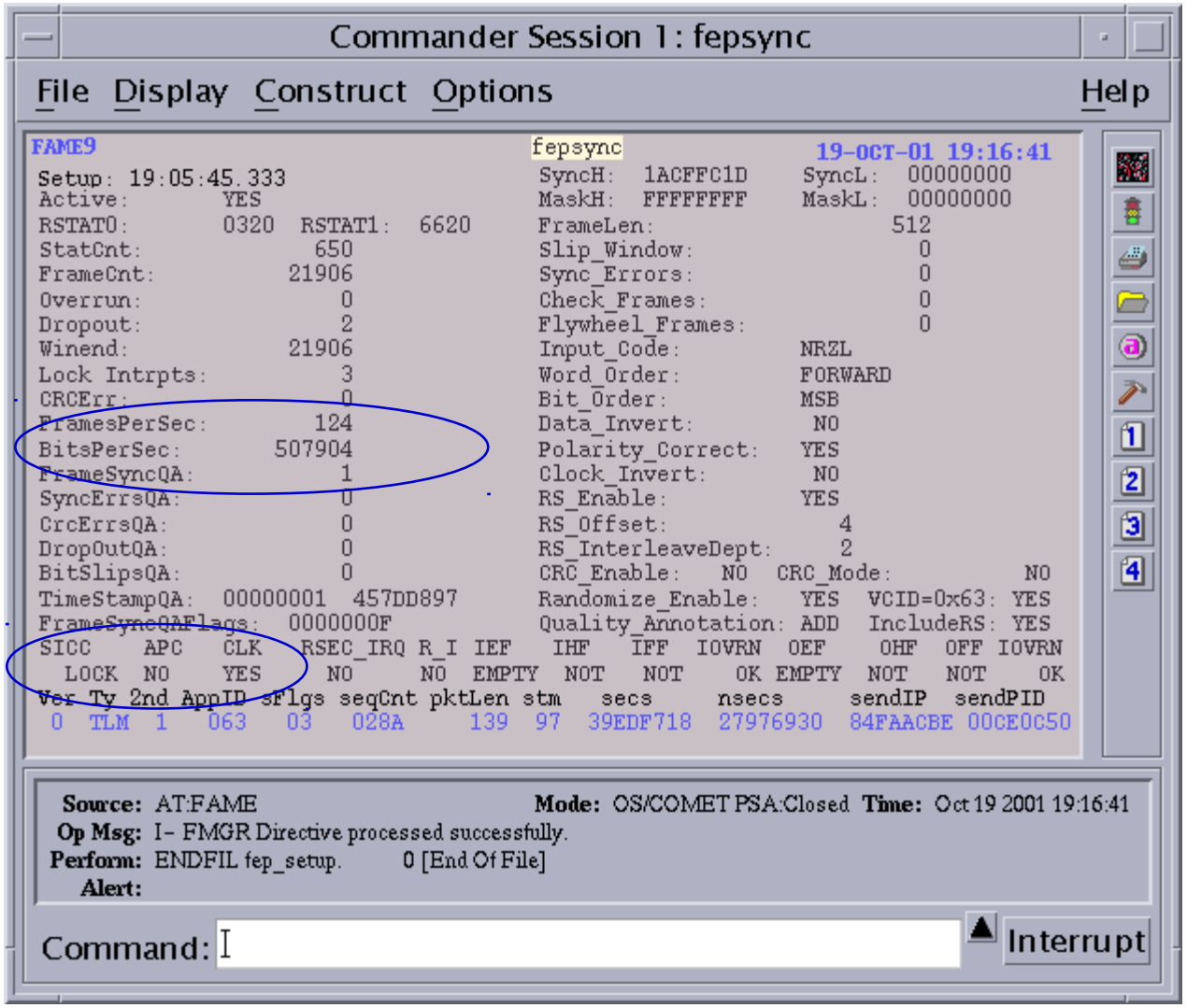
Raw Command


Commander Session 1: ctf_view
File Display Construct Options Help
Flt TBD
Command Transport Frames
Gnd 17-OCT-01 14:08:58
CTF Fields
Type: FSW Command
Sync: FAF320
Path: 07
Version: 0
Bypass: Norm
Control Cmd Norm
Spare 1: 0
Sat Id: 0x8A
Spare 2: 0
Crit Cmd: Norm
Frame Length: 15
Frame Sequence: 49859
Critical Cmd
Crit Cmd Id: 0
FSW Cmd Packet
Version: 0
Type: Cmd
Scndy Hdr Flag: Present
App Proc Id: 0x0C
Sequence Flags: Only
Sequence Count: 0
Packet Length: 3
Command Id: 0x4E
Command SubId: 0
Checksum: D9F1
FSW Cmd Packet Application Data (up to 96 bytes)
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
Lock MF:0013032 VCID:9 VCDU:0013039 VY.MIL
Source: AT:TLM_FRAMES_1,... Mode: OS/COMET PSA:Closed Time: Oct 17 2001 14:08:58
Op Msg: COMMAND TRANSMISSION COMPLETE: NOOP - No Operation
Perform: ENDFIL tlmcrt.per 0 [End Of File]
Alert:
Command:
Interrupt

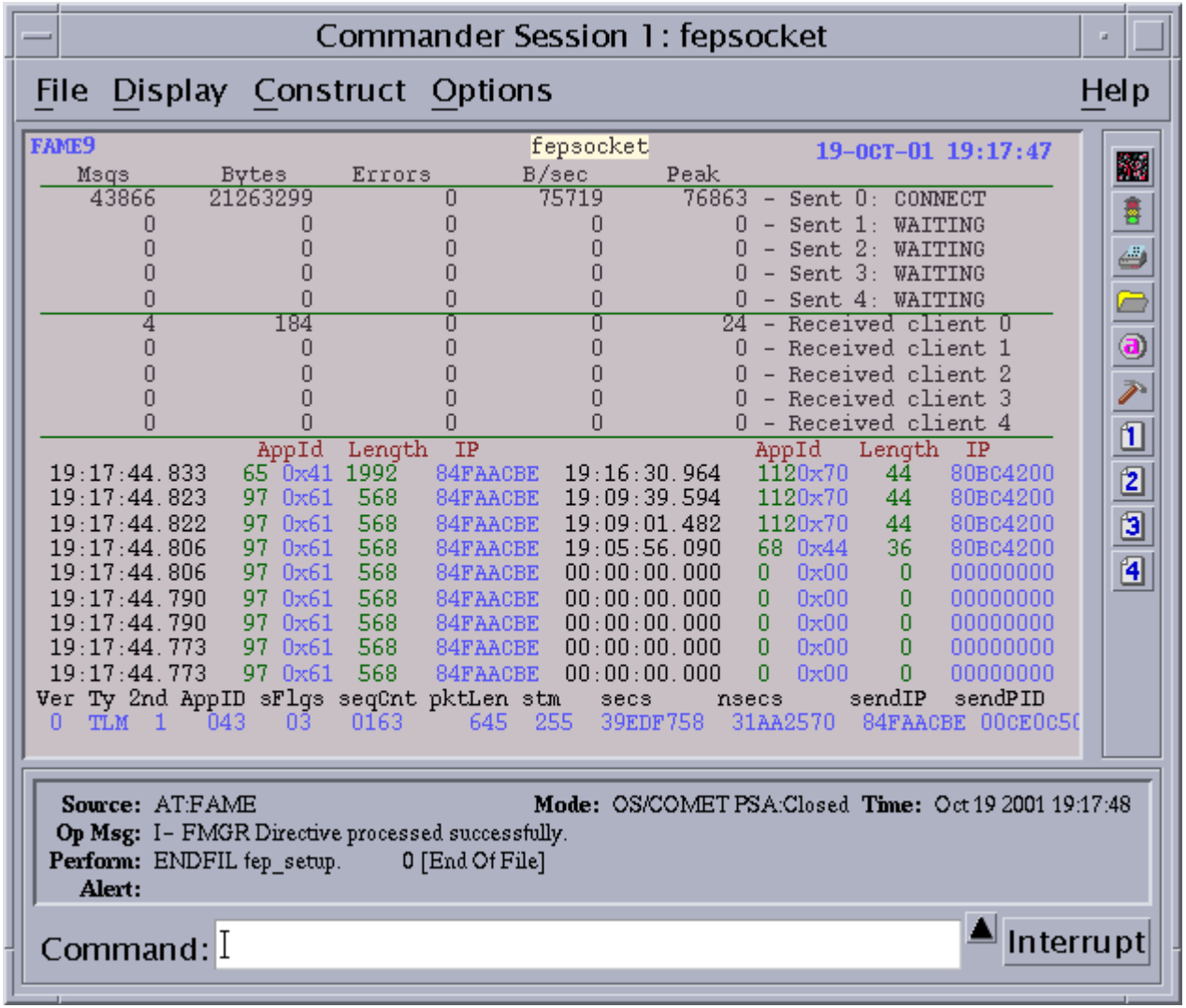
FEP SWB Status



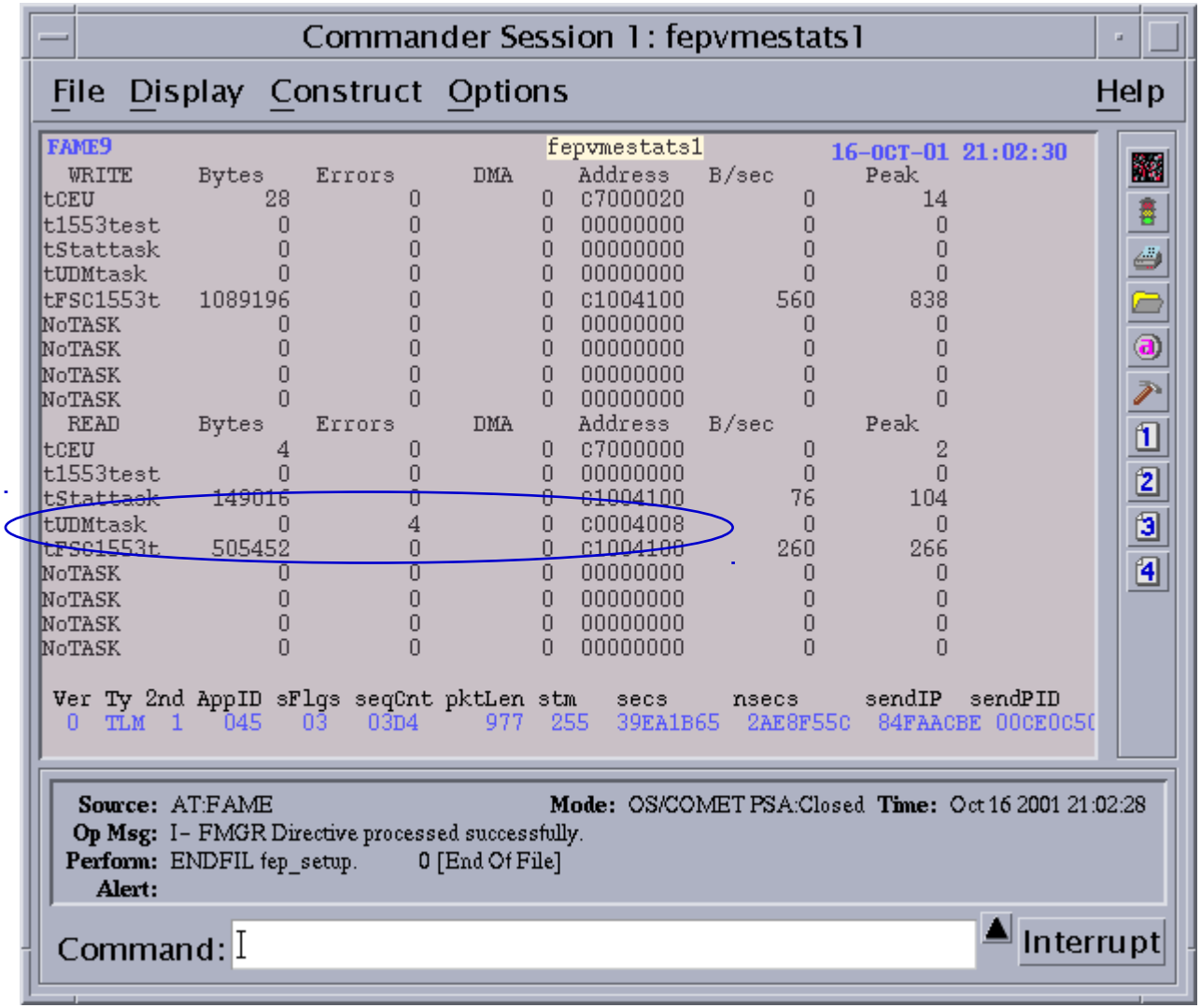
FEP Frame Sync Status



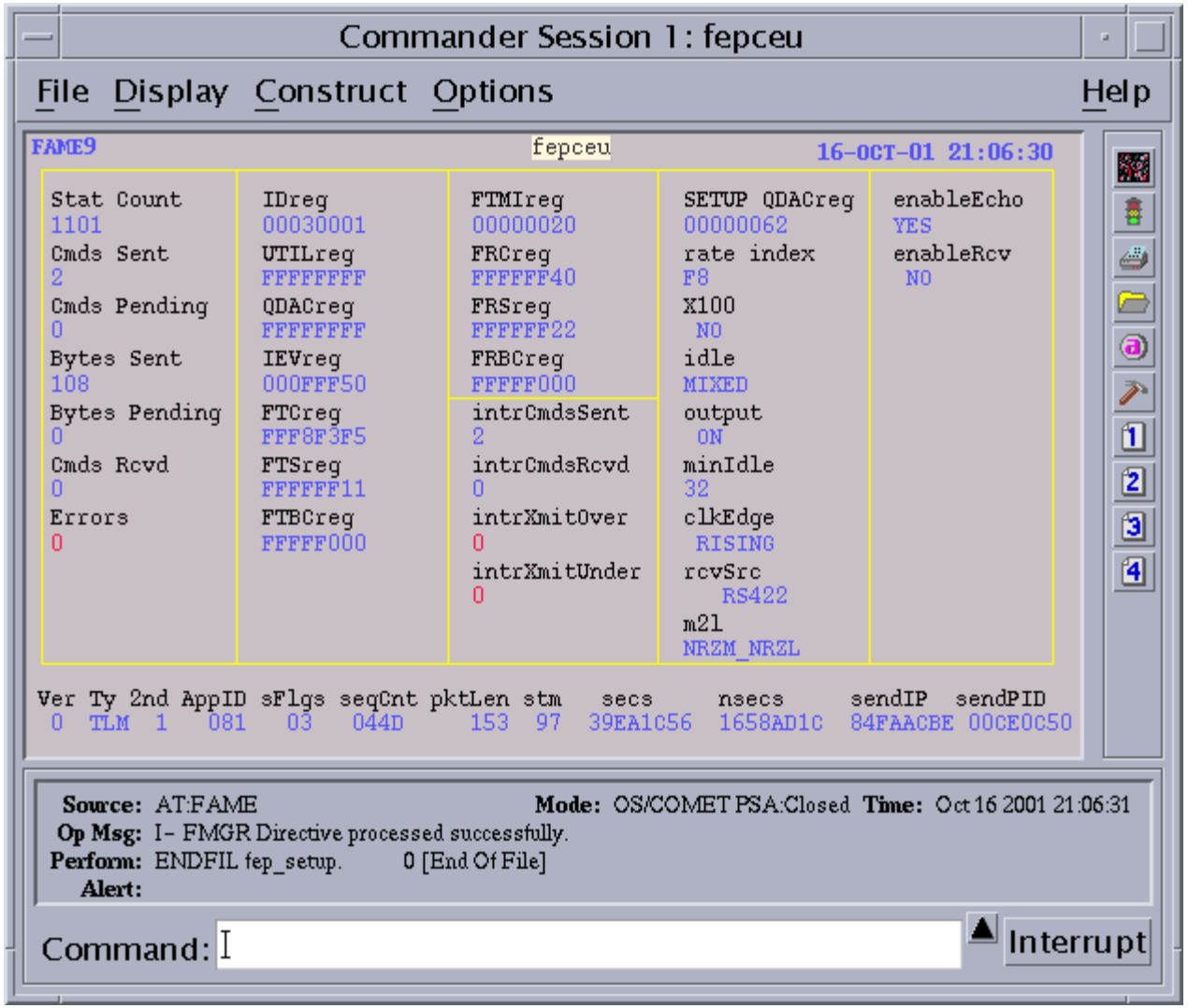
FEP Socket Statistics



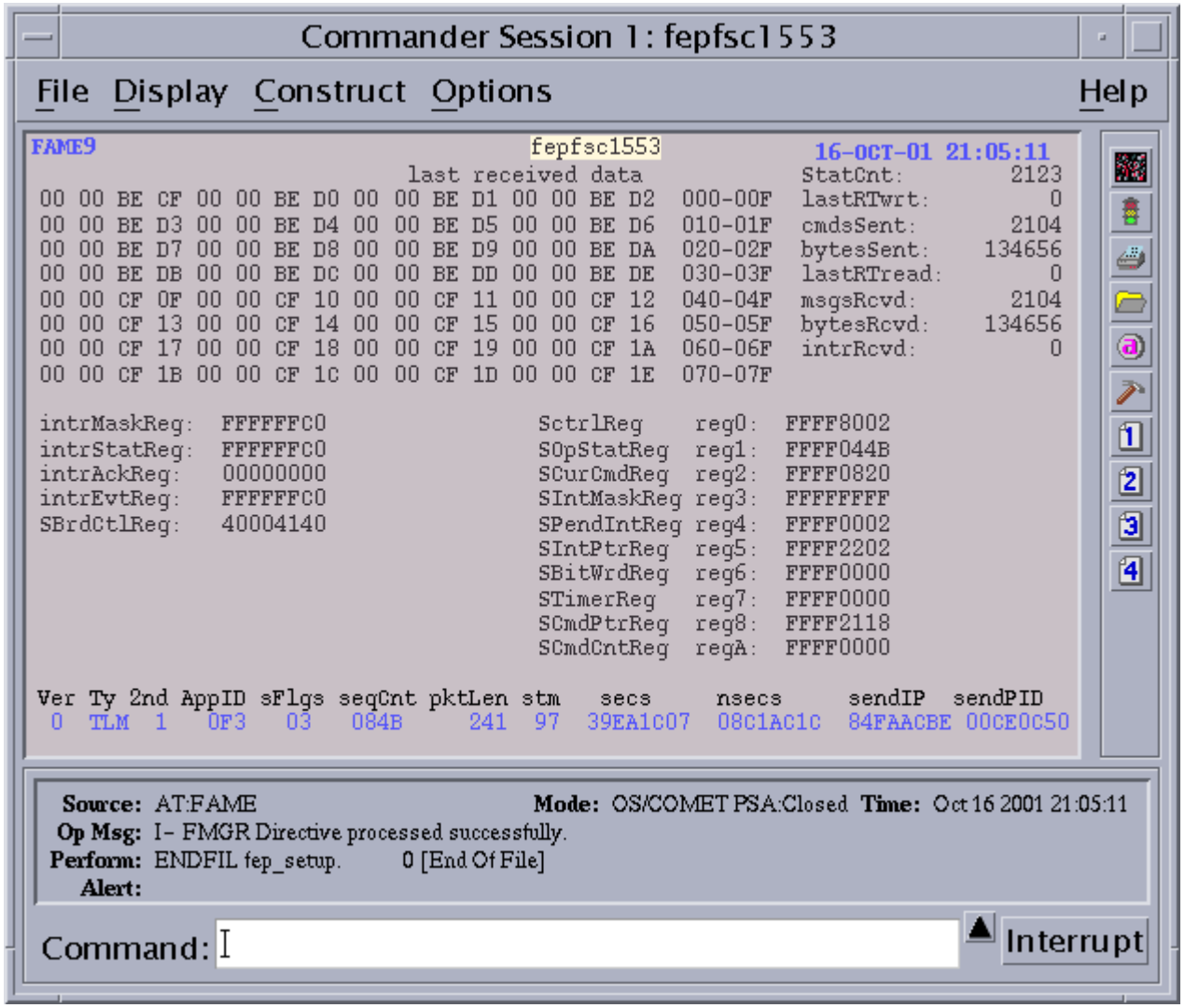
FEP VME Statistics



FEP CEU


Commander Session 1: fepceu
File Display Construct Options Help
FAME9
fepceu
16-OCT-01 21:06:30
Stat Count 1101
Cmds Sent 2
Cmds Pending 0
Bytes Sent 108
Bytes Pending 0
Cmds Rcvd 0
Errors 0
IDreg 00030001
UTILreg FFFFFFFF
QDACreg FFFFFFFF
IEVreg 000FFF50
FTCreg FFF8F3F5
FTSreg FFFFFF11
FTBCreg FFFFF000
FTMIreg 00000020
FRCreg FFFFFF40
FRSreg FFFFFF22
FRBCreg FFFFF000
intrCmdsSent 2
intrCmdsRcvd 0
intrXmitOver 0
intrXmitUnder 0
SETUP QDACreg 00000062
rate index F8
X100 NO
idle MIXED
output ON
minIdle 32
clkEdge RISING
rcvSrc RS422
m2l NRZM_NRZL
enableEcho YES
enableRcv NO
Ver Ty 2nd AppID sFlgs seqCnt pktLen stm secs nsecs sendIP sendPID
0 TLM 1 081 03 044D 153 97 39EA1C56 1658AD1C 84FAACBE 00CE0C50
Source: AT:FAME Mode: OS/COMET PSA:Closed Time: Oct 16 2001 21:06:31
Op Msg: I- FMGR Directive processed successfully.
Perform: ENDFIL fep_setup. 0 [End Of File]
Alert:
Command:
Interrupt

FSC 1553 Board Testing



FSC Test Bed Parts

FSC Testbed (FTB) - Delivery Date 2001/10

Item	Supplier	Serial/Part #	Status	Delivery Date	Unit Price	Comments
Sparc Ultra 2 CPU	Sun	003H2BC8	in T970	6/01	Available	fameds9, Includes Mouse, Keyboard
Sun Monitor	Sun	0010968-516	in T970	6/01	Available	for fameds9
8mm Tape Drive	Sun	004C0276	in T970	6/01	Available	for fameds9
3Com Switch 3300	3Com		in T970	6/01	$1,500	The One We Have Is in Melbourne Being Used By EK
Best Power Fortress	Best	1425UG01014	in T970	6/01	Available	
GPS Time Display	TrueTime	99234644	in T970	6/01	Available	
Nat'l Inst GPIB-Enet	Natl Inst	B8D617	in T970	6/01	Available	To Control HP 6032
VME Chassis	-		in T970	6/01	Available	
SEI VCEU	Silver			8/01	Available	Silver Engineering VME Command Encoder Unit
Avtec RSDEC	Avtec		in T970	6/01	Available	Avtec Sytems VME Framesync Card
SBS Power 4E	SBS		in T970	6/01	Available	300 MHz CPU With 256 Mb RAM
SBS 1553	SBS		in T970	6/01	Available	SBS VME 1553 Interface Card
SEI Instrument sim	Silver			11/01	15000 est.	
Datum Timer bc366	Datum		in T970	6/01	Available	Datum VME Timer Card bc366
SEI IMU, sun sensors	Silver/NRL				10000 est.	
Gimi ACS Box				9/01	Available	
HP 6032A Pwr	HP	US38322386	in T970	6/01	Available	
SEI BPU	Silver			6/01	Available	Silver Engineering Bus Protection Unit
I/O Panel FTB					1000 est.	Not Required for Initial Testing

Software Test Bed Parts

Software Testbed (STB) - Delivery Date 2001/11

Item	Supplier	Serial/Part #	Status	Delivery Date	Unit Price	Comments
Sparc Ultra 2 CPU	Sun	003H29AC	in T970	6/01	Available	fameds8, Includes Mouse, Keyboard
Sun Monitor	Sun	0010968-518	in T970	6/01	Available	fameds8
3Com Switch 3300	3Com			6/01	$1,500	We can use an existing Hub
Best Power Fortress UPS	Best	1425UG01013	in T970	6/01	Available	
GPS Time Display	TrueTime			11/01		
Nat'l Inst GPIB-Enet	Natl Inst	AD5DE0	in T970	6/01	Available	to control HP 6032
VME Chassis	-		in T970	6/01	Available	
SEI VCEU	Silver			8/01	Available	Silver Engineering VME Command Encoder Unit
Avtec RSDEC	Avtec		in T970	6/01	Available	Avtec Sytems VME Framesync Card
SBS Power 7E	SBS		in T970	6/01	Available	
SBS 1553	SBS		in T970	6/01	Available	SBS VME 1553 Interface Card
SEI Instrument sim	Silver			11/01	15000 est.	
Datum Timer bc366	Datum		in T970	6/01	Available	Datum VME Timer Card bc366
SEI IMU, Sun Sensors etc	Silver/NRL			11/01	10000 est.	
Gimi ACS box						
HP 6032A Pwr Supply	HP	US38322380	in T970	6/01	Available	
SEI BPU	Silver			6/01	Available	
I/O Panel STB	-				1000 est.	

EAGE Parts

EAGE - Delivery Date 2002/06						
Item	**Supplier**	**Serial/Part #**	**Status**	**Delivery Date**	**Unit Price**	**Comments**
Sun Ultra 2 - EAGE	Sun					Maybe Acquire W/Out Buying
Sun Monitor	Sun					Maybe Acquire W/Out Buying
3Com Switch 3300	3Com			6/02	$1,500	
Best Power Fortress UPS	Best			6/02		I would Get a Rack Mountable UPS for This (NEMO)
GPS Time Display	TrueTime			6/02		
Nat'l Inst GPIB-Enet	Natl Inst			6/02		to Control HP 6032, Other 488 Devices
VME Chassis	-		in T970	6/01	Available	
SEI VCEU	Silver			6/02	15000 est.	Silver Engineering VME Command Encoder Unit
Avtec RSDEC	Avtec		in T970	6/01	Available	Avtec Sytems VME Framesync Card
SBS Power 7E	SBS		in T970	6/01	Available	
SBS 1553	SBS			6/02		SBS VME 1553 Interface Card
SEI Instrument sim	Silver			6/02	15000 est.	
Datum Timer bc366	Datum		in T970	6/01	Available	Datum VME Timer Card bc366
SEI IMU, Sun Sensors etc	Silver/NRL			6/02	10000 est.	
Gimi ACS Box						
HP 6032A Pwr Supply	HP		in T970	6/01	Available	
SEI BPU	Silver			6/02		Silver Engineering Bus Protection Unit
I/O panel EAGE				6/02		
HP 6032A Pwr Supply				6/02		
SEI BPU				6/02		Silver Engineering Bus Protection Unit
APC UPS 3000RM			in T970	6/01	Available	
Battery Sim			in T970	6/01	Available	Kepco BOP 36-12M
Solar Array Sim			in T970	6/01	Available	HP E4350B
GD Rack Slides	Newark	C-230-S-124				
GD Rack Brackets	Newark	CLB-307				
Battery Sim						Kepco BOP 36-12M
Solar Array Sim						HP E4350B
BPU						
UPS						

ELSE Parts

ELSE - Delivery Date 2004/01						
Item	**Supplier**	**Part #**	**Status**	**Delivery Date**	**Unit Price**	**Comments**
Sun Ultra 2 - EAGE	Sun					Maybe Acquire W/Out Buying
Sun Monitor	Sun					Maybe Acquire W/Out Buying
8mm Tape Drive	Sun			6/01		
3Com Switch 3300	3Com			6/01		
Best Power Fortress	Best			6/01		
GPS Time Display	TrueTime			6/01		
Nat'l Inst GPIB-Enet	Natl Inst			6/01		to Control HP 6032, Other 488 Devices
VME Chassis	-			6/01		
SEI VCEU	Silver			7/01	$15,000	Silver Engineering VME Command Encoder Unit
Avtec RSDEC	Avtect		in T970	6/01	Available	Avtec Sytems VME Framesync Card
SBS Power 7E	SBS			6/01		
Datum Timer bc366	Datun			6/01		Datum VME Timer Card bc366
HP 6032A Pwr				6/01		
SEI BPU	Silver			6/01		Silver Engineering Bus Protection Unit
I/O Panel EAGE						
HP 6032A Pwr			in T970	6/01	Available	
SEI BPU			in T970	6/01	Available	Silver Engineering Bus Protection Unit
APC UPS 3000RM			in T970	6/01	Available	
Battery Sim			in T970	6/01	Available	Kepco BOP 36-12M
Solar Array Sim			in T970	6/01	Available	HP E4350B
GD Rack Slides	Newark	C-230-S-124				
GD Rack Brackets	Newark	CLB-307				
Battery Sim						Kepco BOP 36-12M
Solar Array Sim						HP E4350B
BPU						
UPS						
Rackmount Monitor			in T970	6/01	Available	
~20U Shipping Rack			in T970	6/01	Available	
~10U Shipping Rack			in T970	6/01	Available	

FSC Test Bed
Needed Hardware

- **SEI Instrument Sim Card (Has All Instrument Interfaces)**
- **ARC I/F Sim Card - Available With FSC ARC Card**
- **Pass-1000 1553 Analyzer - Taking From ICM**
- **UPS Power for the Racks**
- **Various Cables**
- **BOBs**

IV&V Status

- **BP Will Provide IV&V**
  - **BP Is Providing the Support**
  - **This Will Facilitate the Transition From I&T to EE&C and Operations**
- **Approach**
  - **BP and FAME I&T Will Create a MOA, BP Will Provide:**
    - **Review the Design and All Documentation**
    - **Review the Design and Code**
    - **Reports for Mark Johnson Prior to System Milestones (CDR, TRR etc.)**
  - **BP Will Provide up to 6 Weeks of Support Through FAME CDR**
- **Scope**
  - **BP IV&V Will Only Provide Coverage for Ground Software Efforts**